INSTRUCTIONS

for the

MODEL 980
MARK II
ANALYZER

INSTRUCTIONS

FOR THE

WESTON MODEL 980 MARK II ANALYZER

Pat. No. D-176044

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by

DAYSTROM, INCORPORATED, WESTON INSTRUMENTS DIVISION
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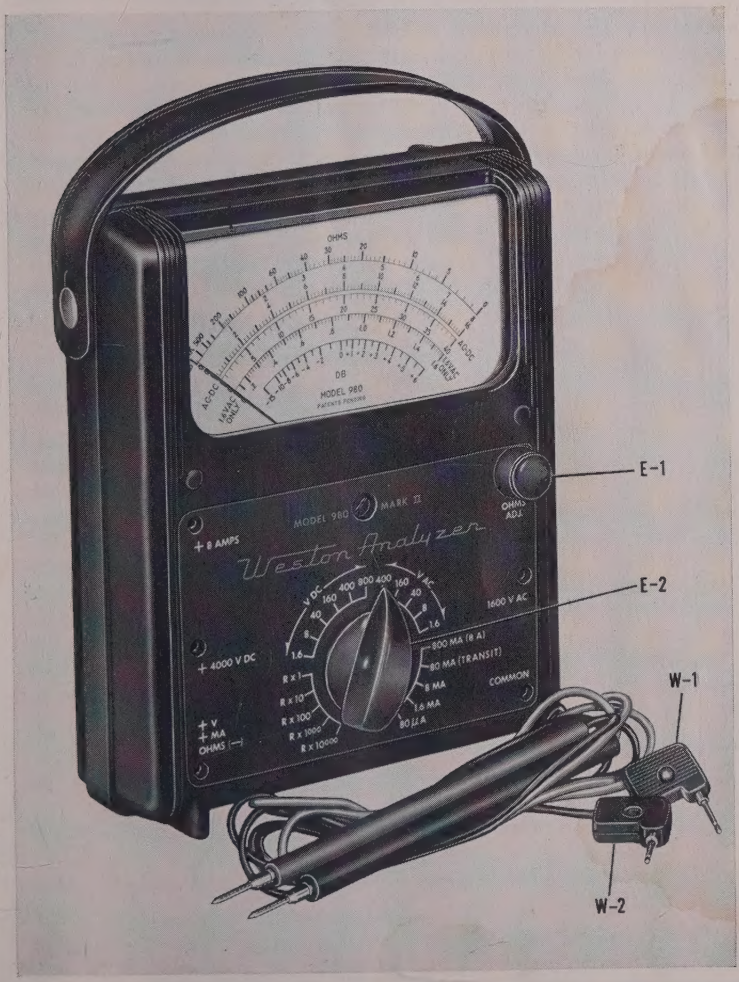

Figure 1. Model 980 Mark II Analyzer

GENERAL DESCRIPTION

GENERAL: The Model 980 MARK II is a compact ultra-sensitive, completely self-contained analyzer housed in a break resistant case. The latest technological advances have been utilized in the design and construction of this device. Precision deposited carbon and wire-wound resistors of ±1% tolerance are used for maximum accuracy. A ¼ amp fuse is also provided in this instrument to protect the ohmmeter circuit from severe overloads.

A single knob and two pin jacks handle all ranges except for the highest AC-DC voltage range and highest current range which are brought out to separate pin jacks. The two lower pin jacks marked $\frac{+V}{+MA}$ $\frac{}{OHMS\ (-)}$ and COMMON are used for all AC-DC voltage ranges, DC current ranges and resistance measurements, with the exception of: 1600V AC, 4000V DC and 8 amps which are brought out to separate jacks. (See Figure 1, Page 3)

Ranges have been chosen to give maximum functional coverage of measurements made in the modern electronics industry. A large 5 inch meter with a scale length of more than 4½ inches provides easy readability. A separate scale has been provided for the 1.6V AC range, while all other AC and DC voltages and DC currents are read on the DC scale. The ohms scale, with 25 ohms center, is figured from 0 to 1000 and is carefully divided to give accurate readings. A full size scale is illustrated on page 16. Weston spring-back jewels, of the type used in ruggedized military equipment, are used in this meter to insure maximum protection against shock damage to the pivots and jewels.

ACCESSORIES: (Not supplied as standard equipment)

1. High Voltage Probe—Model 9896 Type P-400, Weston Part/Drawing No. 153058
2. Test Leads (spare set)—Weston Part/Drawing No. 70033 and 70034
3. Protective Instrument Cover and Tilt Stand—Weston Part/Drawing No. 177977

BATTERY INSTALLATION: Remove the back of the instrument and slip the batteries into their respective mounting clips, observing the polarity as marked on the circuit board next to the clips. The difference in battery size makes it impossible to insert the batteries in the wrong set of mounting clips.

WESTON MODEL 980 MARK II ANALYZER

RANGES: The Model 980 Mark II Analyzer has the following ranges:

DC Volts at 20,000 Ω/v	AC Volts at 1,000 Ω/v	Db	DC Current	Ohms Full Scale	Center Scale
1.6	1.6	−15 to +6	80 μa 1.6 ma	1,000	25
8	8	−1 to +20	8 ma	10,000	250
40	40	+13 to +34	80 ma	100,000	2,500
160	160	+25 to +46	800 ma	1 meg	25,000
400	400	+33 to +54	8 amps	10 meg	250,000
800	1600				
4000					

STEP-BY-STEP OPERATING INSTRUCTIONS

DC VOLTAGE MEASUREMENTS TO 800 V:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in V-Ω-MA pin jack.
3. Rotate SWITCH to desired DC voltage range.

   Caution: If voltage to be measured is unknown, start at 800 v range and work down.
4. Read DC voltage on AC-DC arc.

Switch Setting	Scale Used
1.6 V	16÷10
8 V	8 full scale
40 V	40 full scale
160 V	16 x 10
400 V	40 x 10
800 V	8 x 100

DC VOLTAGE ABOVE 800 V:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in 4000 VDC pin jack.
3. Rotate SWITCH to 400 VDC position.
4. Read DC voltage on AC-DC arc.

Switch Setting	Scale Used
400 VDC	40 x 100

(Continued on the next page)

Caution: Turn *OFF* equipment under test before making test lead connections to the equipment. To avoid shock, do not approach any of the metal parts of the test leads.

AC VOLTAGE MEASUREMENTS TO 400 V:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in V-Ω-MA pin jack.
3. Rotate SWITCH to desired AC voltage range.

   Caution: If voltage to be measured is unknown, start at 400 v range and work down.
4. Read AC voltage above 1.6 VAC on AC-DC arc.
   Read AC voltage less than 1.6 V on 1.6 VAC arc.

Switch Setting	Scale Used
1.6 V	1.6 VAC full scale
8 V	8 full scale
40 V	40 full scale
160 V	16 x 10
400 V	40 x 10

AC VOLTAGE ABOVE 400 V:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in 1600 VAC pin jack.
3. Rotate SWITCH to 160 VAC position.
4. Read AC voltage on AC-DC arc.

Switch Setting	Scale Used
160 V	16 x 100

Caution: Turn *OFF* equipment under test before making test lead connections to the equipment. To avoid shock, do not approach any of the metal parts of the test leads.

Note: If DC is present in the AC to be measured, an external blocking condenser of 0.5 mfd should be added in series with the red test lead.

DC CURRENT MEASUREMENTS TO 800 MA:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in V-Ω-MA pin jack.
3. Rotate SWITCH to desired current range.

(Continued on the next page)

Caution: Always start with switch in 800 ma position and work down until the most accurate reading is obtained.

4. Read DC current on AC-DC arc.

Switch Setting	Scale Used
80 μa	8 x 10
1.6 ma	16÷10
8 ma	8 full scale
80 ma	8 x 10
800 ma	8 x 100

DC CURRENT MEASUREMENTS ABOVE 800 MA TO 8 AMPS:

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in 8 AMP pin jack.
3. Rotate SWITCH to 800 MA position.
4. Read DC current on AC-DC arc.

Switch Setting	Scale Used
800 ma and 8 amp jack	8 full scale

RESISTANCE MEASUREMENTS:

Caution: Make sure all voltage is turned off before connecting the instrument to the device being checked.

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in V-Ω-MA pin jack.
3. Rotate SWITCH to desired ohmmeter range.
4. Short TEST LEADS together and set POINTER to TOP SCALE position by rotating OHMMETER ADJUSTER.
5. Read resistance on the OHMS arc.

Switch Setting	Multiply Readings by	Maximum Current
R x 1	1	60 Milliamps
R x 10	10	6 Milliamps
R x 100	100	600 Microamps
R x 1000	1000	60 Microamps
R x 10,000	10,000	60 Microamps

(Continued on the next page)

DB MEASUREMENTS (—15 to +54 db):

Note: Zero power level is based on 1 milliwatt in a 600 ohm line.

1. Plug BLACK test lead in COMMON pin jack.
2. Plug RED test lead in V-Ω-MA pin jack.
3. Rotate SWITCH to desired range as listed in Step 4.
4. Read db on arc marked —15 to +6 db.

VAC Switch Setting	db Range	Add to reading on —15 to +6 db arc
1.6	—15 to +6	use —15 to +6 arc
8	—1 to +20	+14
40	+13 to +34	+28
160	+25 to +46	+40
400	+33 to +54	+48

If reading is above +54 db, change red test lead to 1600 VAC pin jack and add +60 db to reading on —15 to +6 db arc.

Note: If DC is present in the AC to be measured, an external blocking condenser of 0.5 mfd should be added in series with the red test lead.

Note: When reading —15 to +6 db on the 1.6 volt range the 0 db mark is high due to a-c characteristic of the 1.6 volt range. Use table on next page to determine db level corresponding to voltage indicated.

Note: The instrument has uniform response for frequencies up to 10,000 cycles per second and about 95 per cent response at 35,000 cycles per second.

TRANSIT

When instrument is being transported, maximum damping for meter movement is obtained with the switch set to "80 ma (transit)".

ACCURACY

DC ranges ±2% of full scale.
4000 volt DC range ±3% of full scale.
AC ranges ±3% of full scale.
Ohm ranges ±2 divisions as read on the 16 scale.
±2% of linear arc length on any range (±2°).

DATA ON DB LEVELS

Power Level DB	6 MW in 500 Ohms	Volts, based on 0 DB of 6 MW in 600 Ohms	Volts, based on 0 DB of 1 MW in 600 Ohms
−10	0.548	0.600	0.245
− 9	0.614	0.673	0.275
− 8	0.689	0.755	0.308
− 7	0.774	0.847	0.346
− 6	0.868	0.951	0.388
− 5	0.974	1.067	0.436
− 4	1.093	1.197	0.489
− 3	1.226	1.343	0.548
− 2	1.376	1.507	0.615
− 1	1.544	1.691	0.690
0	1.732	1.897	0.775
+ 1	1.943	2.129	0.869
+ 2	2.180	2.389	0.975
+ 3	2.447	2.680	1.094
+ 4	2.745	3.007	1.228
+ 5	3.080	3.374	1.377
+ 6	3.456	3.787	1.545
+ 7	3.878	4.248	1.734
+ 8	4.351	4.766	1.946
+ 9	4.882	5.347	2.183
+10	5.477	6.000	2.449
+11	6.145	6.732	2.748
+12	6.895	7.554	3.084
+13	7.737	8.475	3.460
+14	8.681	9.509	3.882
+15	9.740	10.67	4.356
+16	10.93	11.97	4.887
+17	12.26	13.43	5.484
+18	13.76	15.07	6.153
+19	15.44	16.91	6.904

(Continued on the next page)

DATA ON DB LEVELS (Con't)

Power Level DB	6 MW in 500 Ohms	Volts, based on 0 DB of 6 MW in 600 Ohms	1 MW in 600 Ohms
+20	17.32	18.97	7.746
+21	19.43	21.29	8.691
+22	21.80	23.89	9.752
+23	24.47	26.80	10.94
+24	27.45	30.07	12.28
+25	30.80	33.74	13.77
+26	34.56	37.87	15.45
+27	38.78	42.48	17.34
+28	43.51	47.66	19.46
+29	48.82	53.48	21.83
+30	54.77	60.00	24.49
+31	61.45	67.32	27.48
+32	68.95	75.54	30.84
+33	77.37	84.75	34.60
+34	86.81	95.09	38.82
+35	97.40	106.70	43.56
+36	109.3	119.7	48.87
+37	122.6	134.3	54.84
+38	137.6	150.7	61.53
+39	154.4	169.1	69.04
+40	173.2	189.7	77.46
+41	194.3	212.9	86.91
+42	218.0	238.9	97.51
+43	244.7	268.0	109.4
+44	274.5	300.7	122.8
+45	308.0	337.4	137.7
+46	345.6	378.7	154.6
+47	387.8	424.8	173.4
+48	435.1	476.6	194.6
+49	488.2	534.7	218.3
+50	547.7	600.0	245.0

THEORY OF OPERATION

DC VOLTS: All DC voltage ranges operate with a sensitivity of 20,000 ohms per volt. The circuit operates as is shown in figure 2.

As the range is changed additional resistance is added in series to obtain the necessary full scale deflection. The fol-

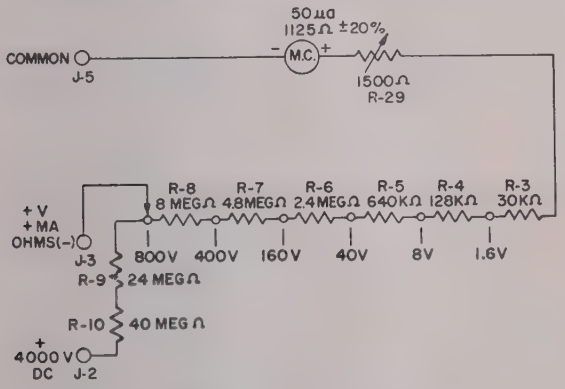

Figure 2. DC Volts Circuit

lowing formula can be used to determine the total series resistance added to the meter for a given range. R = 20,000 x V −2000 where V = voltage range considered. For example, when the 1.6 volt range is selected we obtain R = 20,000 x 1.6 −2000 = 30,000 ohms. The amount of resistance added on any particular range is the difference between the total resistance of that range and the previous range.

AC VOLTS: All AC voltage ranges operate with a sensitivity of 1000 ohms per volt. The applied AC voltage is rectified by a two disc copper oxide rectifier. One disc passes current on the positive cycle, while the other disc passes current during the negative cycle. The resultant DC is read on the DC meter. The rectifier section is factory adjusted to 1 milliampere AC using shunt resistor R-17. As the range is changed, additional series resistance is added ahead of the rectifier to obtain full

scale deflection as in figure 3. The 1.6 AC voltage range is separately adjusted by means of R-18. (See paragraph on calibration, page 14.)

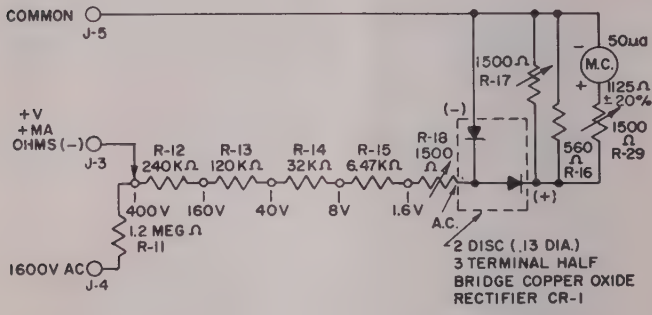

Figure 3. AC Volts Circuit

DB RANGES: The db ranges operate on the same principle as the AC voltage ranges with the exception that the readings are taken on a db arc. Zero power level is based on 1 milliwatt in a 600 ohm line.

OHMMETER RANGES: The ohmmeter ranges are of the series type illustrated in figure 4. In the three lower ranges current flows from the 1.5 volt battery through one of the shunt resistors, according to the range selected, and then returns through the unknown resistor Rx being measured to the battery. The shunt resistor is paralleled by the meter circuit. In the two higher ranges the shunt resistors are eliminated and the current from the battery flows through either R-2 or R-1 according to the range selected, and then returns through the meter circuit and unknown resistor Rx to the battery. On the highest range more voltage is necessary, therefore, the 1.5 volt battery is replaced by a 15 volt battery. The ohmmeter adjuster and a series resistor are in shunt across the meter to compensate for changes in battery voltage.

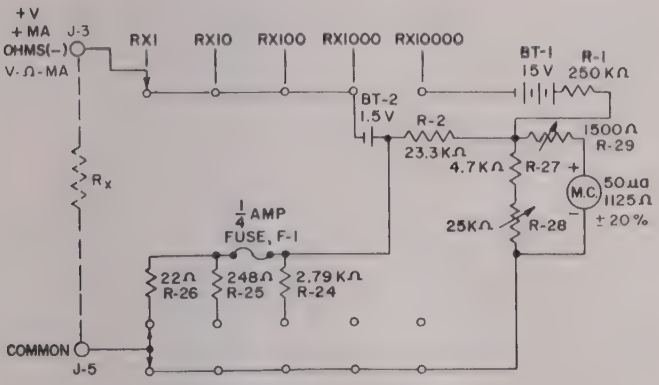

Figure 4. Ohmmeter Circuit

DC CURRENT RANGES: The operation of the current ranges is shown in figure 5, below. The meter sensitivity is varied by means of a series resistor and shunt resistor which change as different ranges are selected. The current divides inversely proportional to the total resistance in each branch of the parallel circuit, with the major portion flowing through the shunt resistor. The total ring shunt resistance remains constant, but as the range is changed, more or less of the

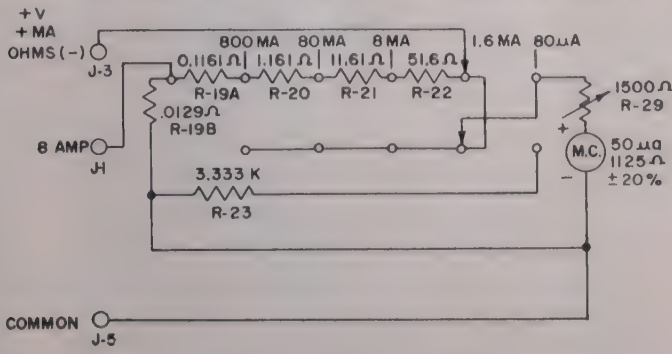

Figure 5. DC Current Circuit

shunt is placed in series with the meter which either increases or decreases the value of the shunt resistor, thus changing the meter sensitivity. The millivolt drop on all current ranges is approx. 100 MV, whereas, on competitive instruments it is 250 MV. This is advantageous when making current measurements in low voltage circuits such as circuits using batteries or transistors.

MAINTENANCE

REPLACEMENT OF BATTERIES: The analyzer has two batteries, a 1.5 volt battery for the four lower ohmmeter ranges and a 15 volt battery for the highest ohmmeter range. When the instrument can no longer reach full scale deflection on any of the four lower ohmmeter ranges when the leads are shorted and the ohmmeter control rotated, the 1.5 volt battery must be replaced. When the instrument can no longer reach full scale deflection on the R x 10,000 range when the leads are shorted and the ohmmeter control adjusted, the 15 volt battery must be replaced. To change either of the two batteries it is only necessary to remove the back of the instrument and slip out the old battery and place a fresh one in its place. (See Figure 7, Page 19)

Caution: When replacing batteries, always observe the polarity which is marked on the circuit board next to battery mounting clips. Failure to do so will cause a downscale deflection on the meter.

CALIBRATION: The Model 980 Mark II is accurately adjusted at the factory, however, should readjustment ever become necessary, proceed as follows:

DC Adjustment

1. Rotate SWITCH to 1.6 MA position.
2. Apply exactly 1.6 MA to the COMMON and +MA pin jacks.
3. Set METER on top mark by adjusting 1500 ohm DC control, R-29, and cement control.
4. The 80μA, all ohmmeter and all DC voltage ranges should all fall in line with the adjustment made in step 3.

AC Adjustment

1. Rotate SWITCH to 160V AC.

2. Set 1.6V calibration control R-18 to its center position.
3. Apply 160V AC to the COMMON and +V pin jacks.
4. Set METER on top mark by adjusting 1500 ohm AC calibration control, R-17. Remove the 160 volts.
5. Rotate SWITCH to 1.6V AC position. Apply 1.6 volts.
6. Set METER on top mark by readjusting 1500 ohm AC calibration control, R-18.
7. Recheck top mark on 160V AC range.
   Note: Cement both adjustable resistors R-17 and R-18.

SWITCH ROTOR: This instrument uses a molded plastic switch rotor to which are attached the contact fingers. Under normal use this rotor should last the lifetime of the instrument. If for some reason the rotor or switch contacts should become damaged, the entire rotor may easily be replaced. To do this it is first necessary to remove the etched plate by unscrewing the two brass studs with the hexagonal heads, and then remove the two screws near the bottom of the plate. The white and black meter leads are unsoldered and then the plate may be lifted out. The switch rotor is removed by slipping the push-on clip off the protruding shaft and replacing the damaged rotor with a new one.

Caution: Before replacing the etched plate index the switch knob to the R x 10,000 position and rotate the rotor until the small hole in it lines up with the small silver dot on the etched plate.

CLEANING PROCEDURE FOR METER WINDOW: To clean window and restore antistatic surface, use Weston STATNUL® which is locally available. Follow instructions on bottle.

COMPONENTS:

1. The components used in this instrument are either ±1% deposited carbon precision resistors or ±1% wire-wound resistors. If for any reason a component becomes damaged it may easily be replaced by clipping off the damaged component in such a manner as to leave the leads protruding up above the plate. When this is done the replacement component may be soldered directly to these leads, thus eliminating the necessity of removing the plate from the instrument.

2. Fuse—A ¼ amp fuse is provided in this instrument to protect the ohmmeter circuit from severe overloads. Failure of the meter to indicate on the R x 1 and the R x 10 ohmmeter ranges is an indication that the fuse has blown. Fuse replacement is easily made by removing the old one from the fuse clip and replacing it with a new ¼ amp, 250V, Littlefuse type 8AG. If a fuse made by another manufacturer is used, make sure that its cold resistance measures 2.7 ohms, otherwise, inaccurate ohmmeter readings will be obtained on the two low ranges.

Figure 6. Full Size Scale—Model 980 Mark II

REPLACEMENT PARTS LIST FOR MODEL 980

Circuit Symbol	Description	Weston Part No.
E-1	KNOB: black bakelite; 5/8 in. dia; 7/16 in. high w/no. 8-32 Allen recess set-screw; for 1/4 in. shaft.	ND-27780 ND-27781
E-2	KNOB: black bakelite; push-on-type; for 1/4 in. shaft 1 5/16 in. dia; 1 5/8 in. high.	
F-1	FUSE: .25 amp; 250 V; Littlefuse 8 AG.	ND-29787
J-1 to J-5	CONNECTOR, RECEPTACLE: female; solder lug terminal; bent on bottom end and soldered to etched circuit panel.	150555
M-1	METER ASSEMBLY	150562
R-1	RESISTOR, FIXED, DEPOSITED CARBON: 250K ohms; ±1%; 1/2 watt.	ND-27690
R-2	RESISTOR, FIXED, DEPOSITED CARBON: 23.3K ohms; ±1%; 1/2 watt.	ND-27684
R-3	RESISTOR, FIXED, DEPOSITED CARBON: 30K ohms; ±1% 1/2 watt.	ND-27685
R-4	RESISTOR, FIXED, DEPOSITED CARBON: 128K ohms; ±1%; 1/2 watt.	ND-27688
R-5	RESISTOR, FIXED, DEPOSITED CARBON: 640K ohms; ±1%; 1/2 watt.	ND-27691
R-6	RESISTOR, FIXED, DEPOSITED CARBON: 2.4 megohms; ±1%; 1 watt.	ND-27693
R-7	RESISTOR, FIXED, DEPOSITED CARBON: 4.8 megohms; ±1%; 1 watt.	ND-27694
R-8	RESISTOR, FIXED, DEPOSITED CARBON: 8 megohms; ±1%; 1 watt.	ND-29784
R-9	RESISTOR, FIXED, DEPOSITED CARBON: 24 megohms; ±1%; 2 watts.	ND-27695
R-10	RESISTOR, FIXED, DEPOSITED CARBON: 40 megohms; ±1%; 2 watts.	ND-29785
R-11	RESISTOR, FIXED, DEPOSITED CARBON: 1.2 megohms; ±1%; 2 watts.	ND-27692
R-12	RESISTOR, FIXED, DEPOSITED CARBON: 240K ohms; ±1%; 1/2 watt.	ND-27689
R-13	RESISTOR, FIXED, DEPOSITED CARBON: 120K ohms; ±1%; 1/2 watt.	ND-27687

(Continued on the next page)

Circuit Symbol	Description	Weston Part No.
R-14	RESISTOR, FIXED, DEPOSITED CARBON: 32K ohms; ±1%; ½ watt.	ND-27686
R-15	RESISTOR, FIXED, DEPOSITED CARBON: 6.47K ohms; ±1%; ½ watt.	ND-27683
R-16	RESISTOR, FIXED, DEPOSITED CARBON: 560 ohms; ±10%; ½ watt.	ND-29783
R-17, 18, 29	RESISTOR, VARIABLE: wire wound; 1,500 ohms; ±20%; 2 watts.	150579
R-19A	SHUNT, INSTRUMENT: 0.1161 ohms; ±1%.	174079
R-19B	SHUNT, INSTRUMENT: 0.0129 ohms; ±1%.	174079
R-20	RESISTOR, STRIP, WOUND: 1.161 ohms; ±1%.	174156
R-21	RESISTOR, STRIP, WOUND: 11.61 ohms; ±1%.	174157
R-22	RESISTOR, STRIP, WOUND: 51.6 ohms; ±1%.	174159
R-23	RESISTOR, FIXED, DEPOSITED CARBON: 3.333K ohms; ±1%; ½ watt.	ND-29788
R-24	RESISTOR, FIXED, DEPOSITED CARBON: 2.79K ohms; ±1%; ½ watt.	ND-27682
R-25	RESISTOR, FIXED, DEPOSITED CARBON: 248 ohms; ±1%; ½ watt.	ND-29782
R-26	RESISTOR, STRIP, WOUND: 22 ohms; ±1%.	174158
R-27	RESISTOR, FIXED, DEPOSITED CARBON: 4.7K ohms; ±10%; ½ watt.	ND-27605
R-28	RESISTOR, VARIABLE: carbon; 25K ohms; ±20%; ½ watt.	150580
S-1	ROTOR ASSEMBLY: switch.	150539
W-1	LEAD, TEST: assembled; red cable.	70034
W-2	LEAD, TEST: assembled; black cable.	70033
BT-1	BATTERY: 15 volt; Eveready no. 411.	Ref. Only
BT-2	BATTERY: 1½ volt; Ray-O-Vac no. 2 LP size "D" leakproof.	Ref. Only
CR-1	RECTIFIER: copper oxide; 0.130 in. disc; pink dot.	89852
TB-1	BOARD, ASSEMBLED: etched circuit.	174146
MP-1	PANEL, FRONT	174197
MP-2	PANEL, REAR	174144

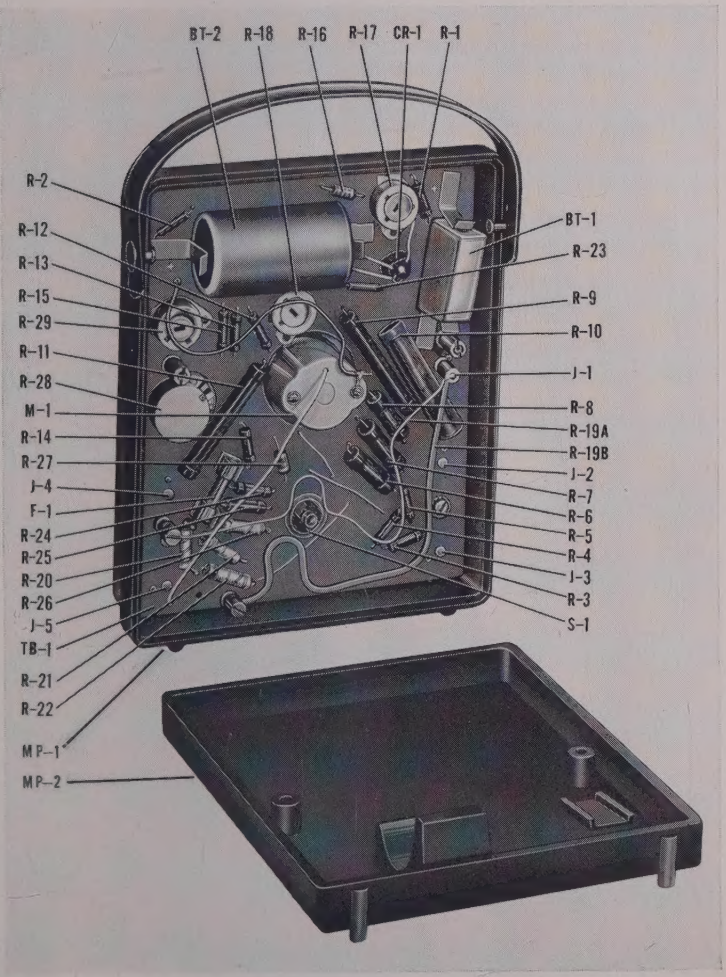

Figure 7. Internal View—Model 980 Mark II

Figure 8. Schematic Diagram—Model 980 Mark II

THE WESTON 980 LINE

MODEL 980 MARK II ANALYZER

MODEL 981 TUBECHECKER

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